Limpet mass and body volume data for respiration measurements from samples collected in Rocky intertidal zone near Hopkins Marine Station in 2013 (Experiments in a Model Ecosystem project)

Website: https://www.bco-dmo.org/dataset/630054
Data Type: experimental
Version: 2016-01-12

Project
» Environmental Variability, Functional Redundancy, and the Maintenance of Ecological Processes: Experiments in a Model Ecosystem (Experiments in a Model Ecosystem)

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Dataset Description

Growth data for animals on experimental plates in the field during 2013 was collected monthly via digital photographs and measured using ImageJ software. Respiration of limpets collected from the field during summer 2013 was measured in air or seawater at a range of temperatures for one hour or two hours.

Related Reference:

Miller, L.P., B.J. Allen, F.A. King, D.R. Chilin, V.M. Reynoso and M.W. Denny (2015). Warm microhabitats drive both increased respiration and growth rates of intertidal consumers. Marine Ecology Progress Series 522: 127-143 doi: http://dx.doi.org/10.3354/meps11117

Download R code: 2013_limpet_mass_analysis.R

Related Datasets (includes metadata)	**Download original data files**
limpet mass and body volume	2013_limpet_mass_master.csv
limpet aquatic respiration	2013_summer_aquatic_respiration_rates.csv
limpet aerial respiration	2013_summer_aerial_respiration_rates.csv

These data are also available at the Stanford Digital Repository: https://purl.stanford.edu/mz343tz6255

Methods & Sampling

Oxygen measurements taken using Ocean Optics FOXY fluorescence-based optode. Limpet mass data for all measured animals is included. Detailed methodology is available in Miller et al (2015).

Data Processing Description

Growth measurements were made by analyzing limpet shell projected area in ImageJ. Limpet respiration time series were used to estimate oxygen consumption rate. Complete analysis for size measurements and derived respiration rates are provided in the attached R code.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- replaced NA with nd (no data)
- replaced spaces with underscores
- sorted data by air_water, then species, then temp

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Data Files

File
limpet_mass_sort.csv (Comma Separated Values (.csv), 125.73 KB) MD5:f60c9743ec4e7d0d0087ad8cbea8f431 Primary data file for dataset ID 630054

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Parameters

Parameter	Description	Units
air_water	whether respiration trial was run in air or water (Reminder that many limpets in this data file were run as pilot trials and not included in the published analysis.)	unitless
species	Lottia species name	unitless
temp	temperature of respiration trial	degrees Celsius
limpet	unique identifying label for each limpet consisting of a 3-character species name abbreviation and a 3 or 4 digit number: lim = Lottia limatula; dig = L. austrodigitalis; sca = L. scabra; pel = L. pelta	unitless
mass_submerged_g	mass of the submerged live limpet in seawater; used for calculation of volume	grams
mass_air_g	wet mass of live limpet (shell + tissue)	grams

mass_empty_shell_g	dry mass of empty limpet shell	grams
mass_tin_tare_g	mass of tin foil weighing dish; used for drying tissue	grams
mass_dry_gross_g	mass of tin foil dish and dried tissue	grams
image_id	corresponding image name for limpet shell (used to calculate projected area of shell)	unitless
mass_tissue_live_g	wet tissue mass; calculated as difference between mass_air_g and mass_empty_shell_g	grams
mass_net_dry_tissue_g	dried tissue mass; calculated as difference between mass_dry_gross_g and mass_tin_tare_g	grams
mass_net_disp_g	net displaced mass; calculated as the difference betweenmass_air_g and mass_submerged_g	grams
vol_limpet_cm3	limpet displaced volume; calculated as mass_net_disp_g * 1.0247 (density of local seawater at 15C = 1.0247 g/cm^3).	cm^3
area_shell_mm2	projected area of limpet shell when viewed from above; measured using the digital image of the shell in ImageJ by painting the outline of the shell and calculating the enclosed area. This same method was used to estimate limpet growth in the field using digital images taken from overhead.	mm^2
date_collection	date that limpet was collected from the field	mm/dd/yyyy
date_trial	date of respiration measurements	mm/dd/yyyy
comment	lists whether limpet shell was intact or chipped. Chipped shells should not be used to calculate the relationship between limpet mass and projected area measured in overhead images.	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	iButton temperature datalogger (DS1921G, Maxim Integrated)
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

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Deployments

Denny_2013

Website	https://www.bco-dmo.org/deployment/630067
Platform	Hopkins Marine Station
Start Date	2013-01-01
End Date	2013-12-31
Description	Limpet growth and respiration studies

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Project Information

Environmental Variability, Functional Redundancy, and the Maintenance of Ecological Processes: Experiments in a Model Ecosystem (Experiments in a Model Ecosystem)

Coverage: Rocky intertidal zone; Hopkins Marine Station, Pacific Grove, CA USA

From NSF award abstract:
Functional traits of species are those that determine either species-specific responses to environmental conditions or their influence on ecological processes. Current theory suggests that communities with many species that perform a given function in a similar way but have different sensitivities to environmental conditions will exhibit greater temporal stability of ecosystem properties. So-called functional redundancy should lead to compensation among species, as some will do better when others do worse in response to environmental variability. Anthropogenic global warming is a major driver of current and anticipated changes in population dynamics, species interactions, and community structure from local to global scales. Resulting changes in biodiversity therefore have the potential to significantly alter important ecosystem properties such as productivity, nutrient cycling, and resistance to disturbance or invasion. Although ecologists have typically emphasized the response of populations and communities to changing climatic averages (e.g., increasing temperature and rainfall), global circulation models also predict significant increases in the intensity, frequency and duration of extreme weather and climate events in many parts of the world; that is, increases in the variability of the physical environment. Unfortunately, our current knowledge about the effects of increasing climatic variation on natural ecosystems is generally quite poor. Predicting how communities will likely respond to changing environmental variability has therefore been recognized as a critical research priority.

This project will advance our understanding of how projected changes in temperature variability will affect the behavior, demography, and interactions of key taxa on rocky shores, a model system for testing theoretical ecological predictions with field experiments. Environmental temperatures strongly influence the physiology, behavior, and demography of most organisms, and changes in average temperature have already been implicated in geographic range shifts of many species. A novel manipulative technique will be used to test the effects of changes in thermal variability on performance by a guild of congeneric grazing limpets, the

productivity of their benthic microalgal food, and the resulting interaction strengths between the two taxa. Energy transfer among trophic levels is a key ecosystem process linked to local food-web support and rates of nutrient cycling. This research will evaluate not only species-specific effects of thermal variability on limpet survival, growth, and grazing activity, but also the potential for functional redundancy among limpet species to maintain that ecosystem function over time as environmental variability increases. Data generated from this study will provide a framework for future investigations of the consequences of climate change in this diverse and productive habitat.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1131038
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